The Forward Market in Emerging Currencies: Less Biased than in Major Currencies

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ABSTRACT

Many studies have replicated the finding that the forward rate is a biased predictor of the future change in the spot exchange rate. Usually the forward discount actually points in the wrong direction. But, at least until recently, those studies applied only to advanced economies and major currencies. We apply the same tests to a sample of 14 emerging market currencies. We find a smaller bias than for advanced country currencies. The coefficient is on average positive, i.e., the forward discount at least points in the right direction. It is never significantly less than zero. To us this suggests that a time-varying exchange risk premium may not be the explanation for traditional findings of bias. The reasoning is that emerging markets are probably riskier; yet we find that the bias in their forward rates is smaller. Emerging market currencies probably have more easily-identified trends of depreciation than currencies of advanced countries.

JEL classification:
F31

Keywords:
forward discount, forward premium, bias, puzzle, emerging markets, uncovered interest parity, exchange risk premium, exchange rate

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Thirty years ago, researchers found the forward exchange rate to be a biased predictor of the future spot exchange rate. Worse, in a regression of the future change in the spot rate against the forward discount, the exchange rate was found on average to move in precisely the *opposite* direction from what was predicted.[1] This surprising finding has been replicated many times since, on many sets of data, and with many refinements. But virtually all the tests have been applied to major currencies and industrialized countries, not to currencies of developing countries. By now enough emerging market currencies are represented by forward markets that it is possible to apply the same tests to them.[2]

1. Introduction: Tests of Bias in the Forward Discount

Although many explanations have been given for the finding of bias in the forward market, they fall into two categories. The first category of explanations, to which an apparent majority of authors subscribe, maintains the assumption of rational expectations, and interpret the systematic component of the forward market's prediction errors as a risk premium. The second category attributes the systematic component of the

[1] The first tests included Rogoff (1977), Hansen and Hodrick (1980), and Frankel (1980); they included consideration of two problems of the error term distribution: moving average errors (from overlapping contracts) and non-normal distributions (from the "peso problem"). Tryon (1997) was the first to run the regression in the form of changes relative to the contemporaneous spot rate, and Fama (1984) made this specification famous. Useful surveys of the original literature include Hodrick (1987), Froot and Thaler (1990), Engel (1995) and Lewis (1995). More recent contributions to the literature include Bacchetta and van Wincoop (2005), Backus, Foresi and Telmer (2002), Breuer (2000), Verschoor and Wolff (2001), Lustig and Verdelhan (2005), Verdelhan (2006), Lustig, Roussanov and Verdelhan (2008), Burnside, Eichenbaum, and Rebelo (2007), Gospodinov (2009), and Farhi and Gabaix (2008), among others.

[2] Bansal and Dahlquist (2000) test whether the interest differential for developing countries is an unbiased forecast of future exchange rate changes. Similarly, Lee (2006) includes 16 countries in his study of uncovered interest parity. Flood and Rose (2002) find that the bias in the interest differential is less for crisis countries, while not significantly different between developed versus developing. But one cannot invoke covered interest parity, and thereby associate such findings with forward rate bias, in the same way one could for advanced countries. The reason is that many of these countries have capital controls, default

forward rate's prediction errors to expectation errors on the part of market participants that are themselves systematic, at least within the sample.[3] Algebraically, the regression equation is:

$$\Delta s_{t+1} = \alpha + \beta fd_t + \varepsilon_{t+1}, \qquad (1)$$

where Δs_{t+1} is ex post future percentage depreciation, defined as $s_{t+1} - s_t$, fd_t is the forward discount, of a maturity matching that of the ex post depreciation, defined as $f_t - s_t$, $s_t \equiv$ log of the spot exchange rate at time t (defined as domestic units per foreign), and $f_t \equiv$ log of the forward exchange rate at time t.

The null hypothesis of unbiasedness is $\beta = 1$. The null would imply that there is no systematic time-varying component to the prediction errors: $E_t \Delta s_{t+1} - fd_t = \alpha$. The null hypothesis is actually a joint hypothesis, comprising of two distinct conditions: rational expectations: $E_t \Delta s_{t+1} = \Delta s_t^e$, plus no time-varying risk premium: $rp_t \equiv E_t \Delta s_{t+1} - fd_t - \alpha = 0$, where $E_t \Delta s_{t+1}$ is the mathematical expectation (within-sample), and Δs_t^e is the expectation held by investors. ε_{t+1} is the error term, which would be equal to the forward market prediction error under the null hypothesis. But the null hypothesis is almost always rejected statistically, and often the finding is $\beta < 0$. The question then becomes whether the findings of bias are to be interpreted as a time-varying risk premium, or as systematic expectation errors.

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risk, and interest rates that are not freely determined in the marketplace. More recently, Gilmore and Hayashi (2008) have analyzed the forward premium puzzle for emerging market currencies.

[3] This phrasing is intended to be broad enough to include the peso problem, learning, and other sources of error patterns that appear statistically significant within the sample. The definition need not necessarily imply that market participants are irrational. Among those who fall into the category of attributing the findings of bias to expectational errors are Froot and Frankel (1989) and Campbell, Koedijk, Lothian, and Mahieu (2007).

The simple purpose of this paper is to test for bias in the forward markets in emerging market currencies, and to see how the bias compares to that for major currencies. One motivation is to shed some possible light on the two competing interpretations of bias. Intuitively, emerging market currencies are probably riskier to hold than major currencies; one might think that the risk premium would therefore be larger and more variable than for major currencies. At the same time, emerging market currencies are more prone to bouts of high inflation and other sources of medium-term trends, so that one might think it would be easier to forecast the direction of movement of the spot rate than is the case for major currencies, where the exchange rate is closer to a random walk.[4] If the bias is greater for emerging market currencies, that would point toward the risk premium interpretation; if less, then the other interpretation. We hasten to add that this suggested motivation is not demonstrated on the basis of formal theory. It would be hard to do so. It would not be easy, for example, to rule out the possibility that even though emerging market currencies have higher variance, their risk is highly diversifiable so that the risk premium could in theory go the other way.[5] However, there is a bit of evidence, from survey data, that investors indeed find it easier to forecast the direction of movement of emerging market currencies than of major currencies.[6]

In the financial markets, efforts to exploit the forward discount bias generally go under different-sounding names. Exploiting the bias means "going long" in the currency that sells at a forward discount, relative to others. By covered interest parity, this is the same thing as going long in the currency that pays a higher short-term nominal interest

[4] Huisman, Koedijk, Kool, and Nissen (1998) find less bias in periods when the forward discount or premium is large. Similarly, Lothian and Wu (2005) find that large interest rate diffentials have significantly stronger forecasting powers for currency movements than small interest rate differentials.
[5] Poonawala (2004).

rate, relative to others. Among European currencies in the early 1990s – with Italian interest rates, for example, above German interest rates – this strategy was known as the *convergence play*. The convergence play again became relevant in the 2000s for Central European currencies hoping to join the euro.[7] In the mid-1990s, with Japanese interest rates very low, the strategy of borrowing in yen and going long in other currencies – especially dollar-linked currencies in Asia – was known as the *yen carry trade*. During the years 2001–2006, with US interest rates very low, the strategy of borrowing in dollars and going long in euros or emerging market currencies has been known as the *dollar carry trade*. One striking pattern about these episodes is that there are long intervals during which one would have happily made money on average with these strategies, but that these intervals were dramatically punctuated (though not fully reversed) by crises, in 1992 in Western Europe, 1997–98 in East Asia, and 2008 in Central Europe, Iceland, and elsewhere.[8] Again, all these strategies are equivalent to attempts to exploit the finding of forward discount bias, which constitutes another motivation for testing to see whether the finding extends equally to emerging market currencies.

The paper examines forward markets for 35 currencies, classified under the two broad groupings of emerging market currencies versus the currencies of advanced economies countries (including the 11 original European Monetary Union countries).

Our results show that the bias in the forward discount for emerging market economies is smaller than for advanced economies. While we reproduce the standard

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[6] Chinn and Frankel (1994, 2002).
[7] Residents of Hungary and Poland went short in euros and Swiss francs
[8] Brunermiester, Nagel and Pedersen (2008) document the sudden unwinding of carry trades in crashes. Farhi, Fraiberger, Gabaix, Ranciere, and Verdelhan (2009) find that crash risk premia account for about ¼ of average carry trade returns in advanced countries. Frankel (2008) offers a view of the carry trade for non-specialists.

finding that the coefficient is substantially less than zero for industrialized economies, and generally highly significant statistically, we find that the coefficient is much closer to zero for emerging market currencies: often positive and seldom significantly less than zero. To us the fact that the bias is stronger for advanced country currencies, which are presumably more stable, suggests that it may not be entirely due to an exchange risk premium.

2. The Data Sample

Although many national money markets have been liberalized since the 1970s, there is still only a relatively limited set of currencies in which forward exchange contracts are actively traded by international investors. Thus Asia is more heavily represented in our sample than Latin America or, certainly, Africa. Countries in our analysis have been classified as emerging market economies based on the IMF Country Grouping Classification.[9] These also include some countries that are classified by the IMF as newly industrialized economies: Hong Kong, Singapore and Taiwan.

Our regression analysis proceeds first country by country, and then pooled. We start on December 31, 1996, because data are not available for enough emerging markets before then. In order to understand the impact of the Asian Financial Crisis of the late 1990s, two sets of regressions have been conducted: one includes the period of financial crisis, while the other does not. The results from the regression analysis starting December 1996 onwards are presented in Section three. Regression results for post Asian financial crises (from December 1998 onwards) are reported in Appendix V of the

[9] See Appendix I for more details on data set. Appendices are available in Poonawala (2004).

working paper. We use Seemingly Unrelated Regressions (SUR) to correct for the likely correlation of the error term across currencies.

We have 14 currencies classified as emerging.[10] (Dates and graphs of exchange rates over time are available in Appendices I, II, III and IV of the working paper.) Some countries with tightly fixed exchange rates were not included in the analysis. Hong Kong has been included, even though it has a currency board, because there is a small band which allows some room for movement. Leaving out specifically all those emerging market currencies that had stable currencies might bias the sample in favor of volatile emerging market currencies. Recent literature has emphasized the difficulty in establishing whether a declared flexible exchange rate regime is in fact just *de jure* or also *de facto*. Countries with capital controls (India) are not excluded from our sample. An established forward market in these countries shows that there exists a demand for forward exchange transactions.

As has long been recognized in this literature, the use of overlapping contracts (3-month forward contracts observed at a one-month frequency) creates a moving average error process. We address this problem in the simplest way possible: by using non-overlapping contracts. Our data are sampled at the same frequency as the horizon of the forward exchange rate – one month. It is necessary to avoid 'mismatching' which would involve incorrect pairing of the forward exchange rate and the future spot rate to which it

[10] Indonesia, where the end-date of available forward exchange rate data does not coincide with the data-sets available for other countries was included in individual country regressions, but was dropped from the pooled regression.

pertains. Specifically, we use the forward and spot exchange rates from the last working day of each month.[11] (Raw data are reported in Appendix VI of the working paper.)

3. Results Country by Country

We begin with the country by country regression results, presented in Table 1. The scatter plots for each country are illustrated in Figures 1 and 2. To repeat the regression equation,

$$s_{t+1} - s_t = \alpha + \beta (f_t - s_t) + \varepsilon_{t+1}. \qquad (2)$$

The coefficient estimates bounce around a lot. This is especially due to the inclusion of countries with capital controls or announced pegs. It is important to remember that the forward discount regression was always intended to be a test of the null hypothesis of unbiasedness, rather than estimation of any alternative-hypothesis structural equation, so that stable coefficients are not to be expected.

The results confirm the usual finding of a strong forward rate bias for most of the industrialized country currencies. All the currencies except for the Greek drachma and Japanese yen show coefficients that are statistically less than one at very high significance levels. Most of the advanced countries show coefficients that are also significantly less than zero at the 5% level. Only Canada, Greece, Italy, Japan and the UK are not significant at the 5% level. Thus we can reject the hypotheses that the coefficient β is zero for sixteen of the twenty-one advanced economies, and we can also

[11] Breuer and Wohar (1996) identify timing pitfalls, and suggest that they can be reduced by taking data from the middle of the month instead of the end.

reject the hypotheses that $\beta=1$ for nineteen of the twenty-one countries in our advanced country sample.

[INSERT TABLES 1, 2 and 3 here]

[INSERT Figures 1 and 2 here]

Our key result first appears in Table 2: the emerging market economies have coefficients that are generally less negative than their developed country counterparts. More are greater than zero than negative. The average coefficient for emerging market economies is also positive: 0.0033, versus -4.3331 for advanced economies. To be sure, the forward market is still a biased predictor for more than half of the emerging currencies: we can easily reject the hypothesis that the coefficient is 1.0 for eight of the fourteen emerging market economies (Hong Kong, India, Indonesia, Mexico, Saudi Arabia, South Africa, Taiwan and Turkey). But in none of the emerging market currencies is the coefficient statistically less than zero at the 5% significance level.

Thus far the results support a substantial difference between the results of the industrialized economies and the emerging markets. That the absolute values for emerging markets are smaller suggests that the forward exchange rate is a less biased indicator for the future expected spot rate in emerging market economies.[12]

Next, in Table 3, we correct for correlation of the error term across countries in the error term, using the technique of Seemingly Unrelated Regressions (SUR).[13] The SUR analysis starts from October 1997, which is the starting point for India and Hungary

[12] Appendix 5 presents the regressions results for the data set not including the turbulent period covering the Asian Financial crisis.

[13] Such a correlation is almost inevitable when using bilateral exchange rates. For example, a strong dollar or a contagious currency crisis in a particular month would likely show up across many of the bilateral dollar exchange rates.

in our dataset, so as to standardize the number of observation dates. Therefore all currencies have 78 data points.

Except for South Africa, and Canada and Japan, which appear as outliers in their sets – emerging market economies and advanced economies respectively – the emerging markets under SUR all continue to yield coefficient estimates that are less negative than all the industrialized economies. Among advanced currencies, 5 of 10 show coefficients that are clearly significantly less than zero, while among emerging markets only 2 of 14 do (Mexico and South Africa).

4. Results from Pooled Analysis

We next attempt, in Table 4, to capture more information from our data set by running a pooled country regression analysis with all currencies constrained to have the same coefficient within each class of countries. The pooled analysis lets us bring all the data to bear at once to get the best estimator. We keep separate pools for the emerging market economies and the industrialized economies. (See Figure 3.) To eliminate double counting of observations, only the Euro has been included in the pooled analysis for industrialized economies; individual EMU member countries have been excluded. This brings the number of advanced countries included in the pooled regression analysis from 21 to 10.

The β for the pooled analysis for emerging market currencies is -0.028. This estimate is significantly less than 1.0 at the 5% level. However we cannot reject the hypotheses that $\beta=0$. The coefficient for the pooled analysis for advanced economies is -2.023 (shown in graph below). Again, while we can reject the hypothesis $\beta=1$ at the 5%

level, and we can reject $\beta=0$ for the advanced economies, we cannot do so for the emerging markets. Increasing the '*n*' leads us to a sharper difference in the estimated β with a more negative value for the industrialized economies than for the emerging markets.

[INSERT TABLES 4, 5 and 5b Here]

[INSERT Figure 3 here]

We also run Seemingly Unrelated Regressions in the pooled regression analysis to address cross-currency correlation. (See Table 5) The pooled SUR analysis dropped observations for the last three countries, alphabetically (Taiwan, Thailand and Turkey), to make the number of emerging market observations equal the advanced countries (ten currencies for each).

A similar analysis of the simple (i.e., without SUR) Pooled Country analysis without Taiwan, Thailand and Turkey is reported in Table 5b, to allow comparison. The results are similar: the estimated coefficient is above zero, but insigificantly so. (Illustrated in Figure 4.)

[INSERT Figure 4 here]

5. Conclusions

The regression analysis conducted in this paper produces a striking result. While the bias in the forward discount as a predictor of the future change in the spot exchange rate is present among emerging market currencies and advanced country currencies alike, the bias is less severe in the former case than in the latter. Unlike major currencies, which generally show a coefficient significantly less than zero, suggesting that the

forward rate actually points in the wrong direction, the coefficient for emerging market currencies is on average slightly *abov*e zero, and even when negative is rarely significantly less than zero. One implication for traders is that the "yen carry trade" and "dollar carry trade" on average may not be as profitable when the strategy is to go long in emerging market currencies as when it is to go long in major currencies. An implication for international finance theorists, in light of the intuitively high riskiness of emerging currencies, is that the source of forward discount bias does not lie entirely in the exchange risk premium.

Acknowledgements

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Appendix

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Appendix Table 3b: Seemingly Unrelated Regressions (Country-Wise – Emerging Economies)

Appendix Table 4: Pooled Country Regressions (10/31/97 – 08/30/2004)

Appendix Table 5: Seemingly Unrelated Regressions I (Pooled Without Saudi Arabia, Turkey And Hong Kong)

Appendix Table 6: Seemingly Unrelated Regressions Ii (Pooled Without Taiwan, Thailand And Turkey)

[INSERT ALL 7 APPENDIX TABLES LISTED ABOVE HERE]

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Figure Legend

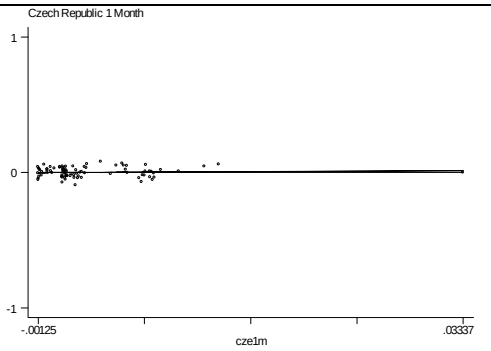
Figure 1: Spot on Forward Regression for Emerging Economies 12/1996 – 4/2003

Figure 2: Spot on Forward Regression for Industrialized Economies 12/1996 – 4/2003

Figure 3: Pooled Analysis (including 13 emerging market currencies)

Figure 4: Pooled Analysis (10 currencies in each category)

Figure 1: Spot on Forward Regression for Emerging Economies 12/1996 – 4/2003



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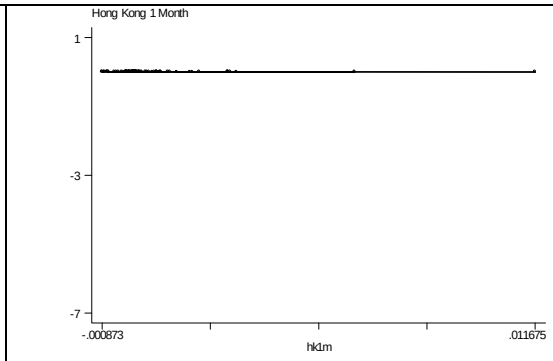

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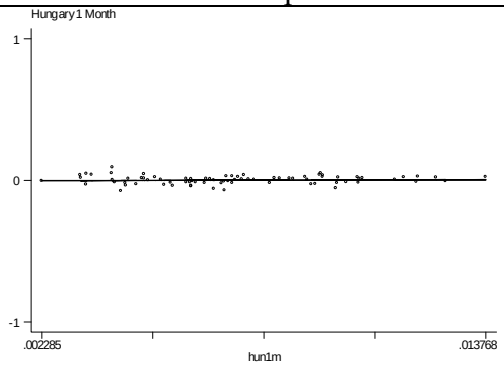

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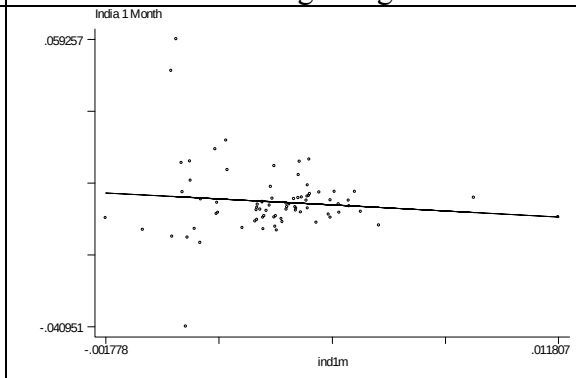

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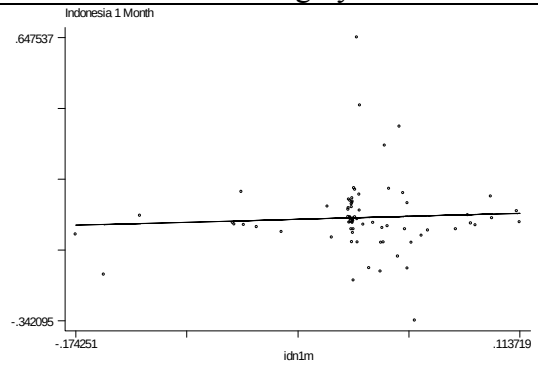

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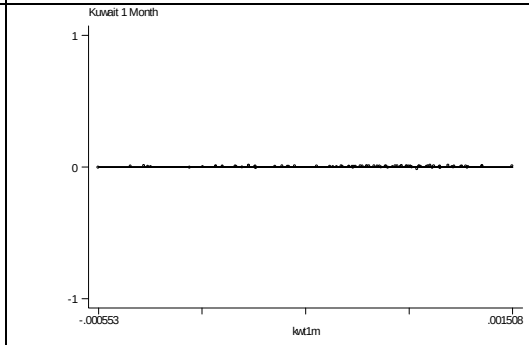

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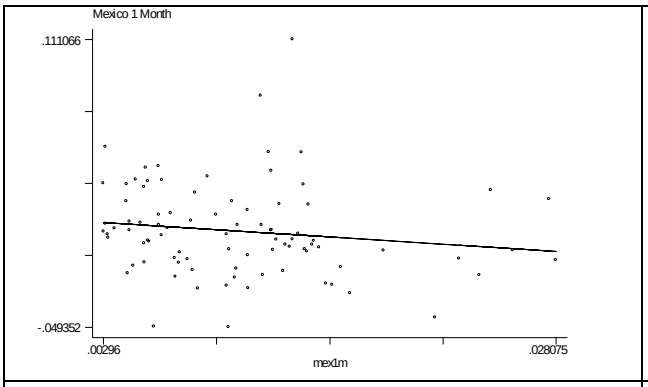

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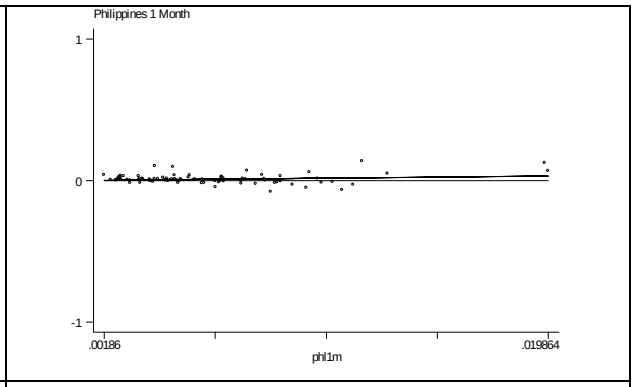

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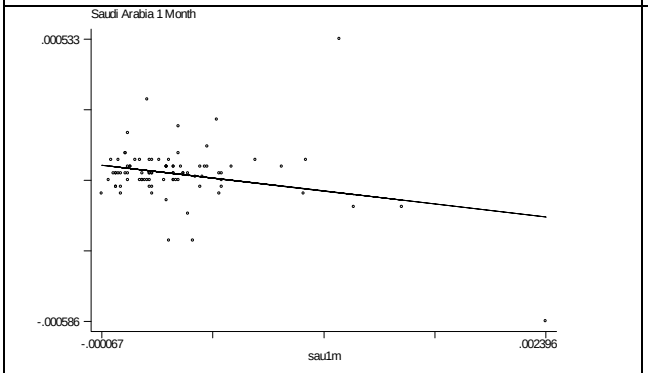

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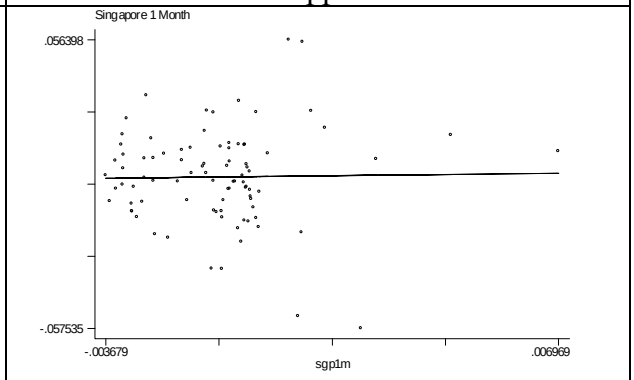

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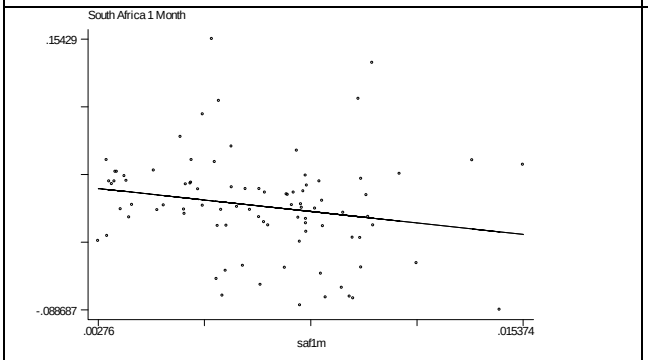

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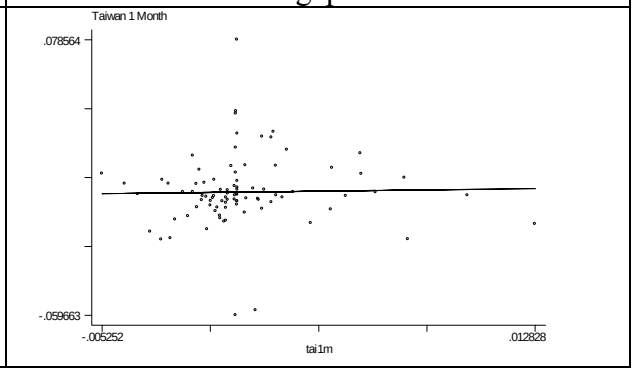

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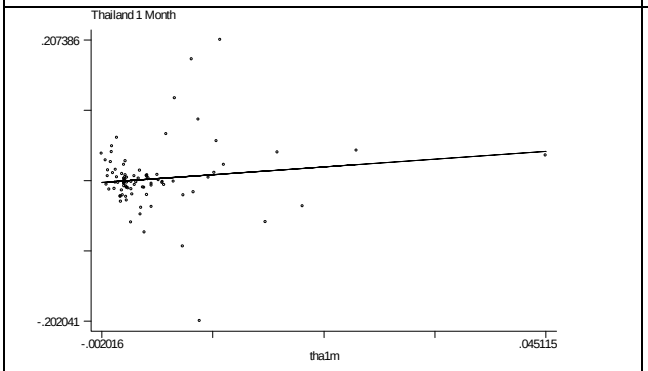
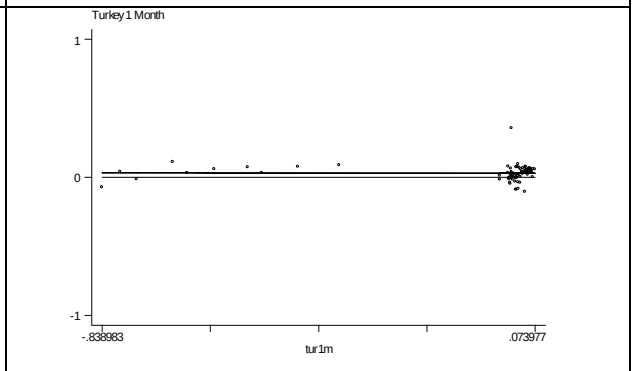
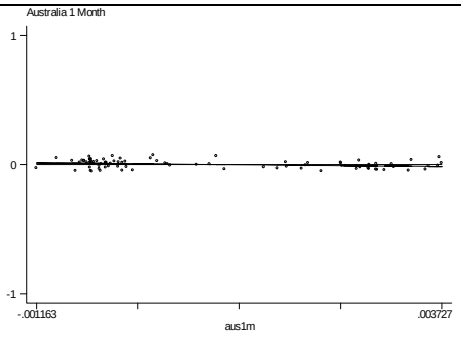


Thailand

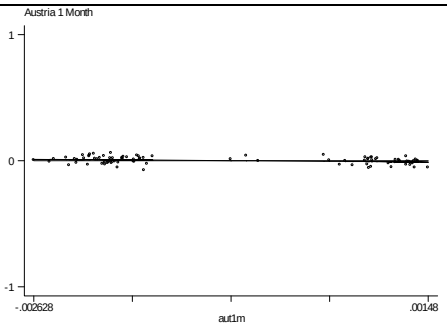


Turkey

Figure 2: Spot on Forward Regression for Industrialized Economies 12/1996 – 4/2003



Australia



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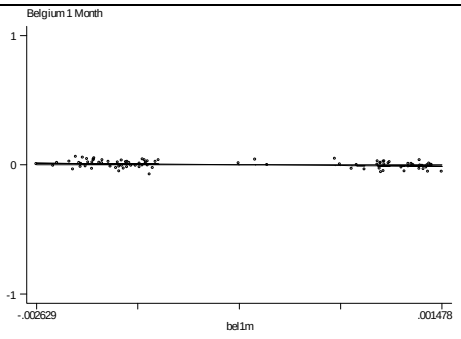
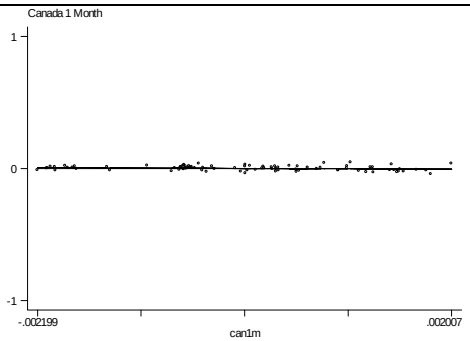
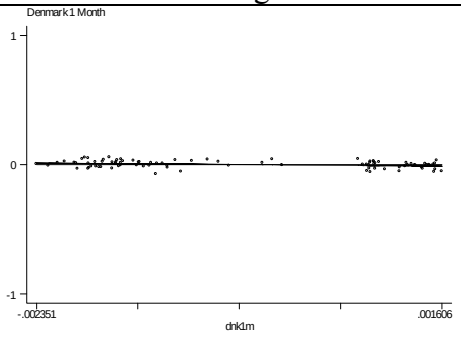


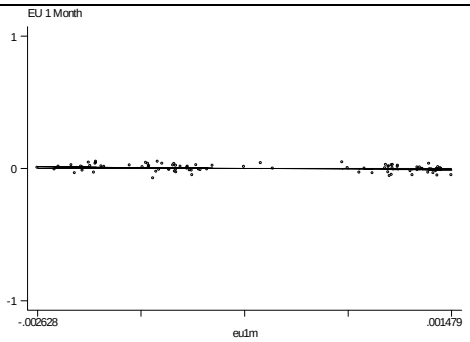
Belgium



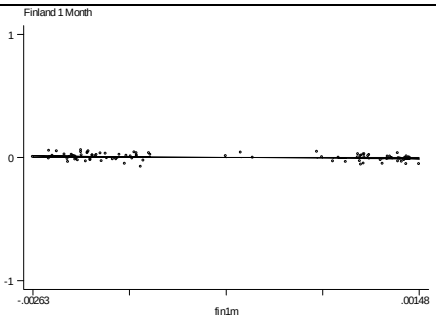
Canada



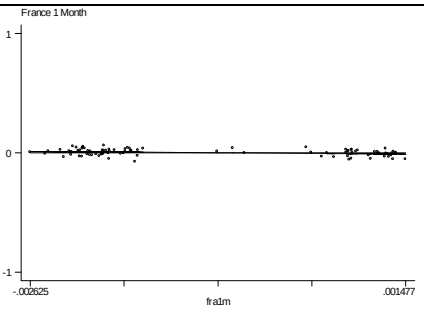
Denmark



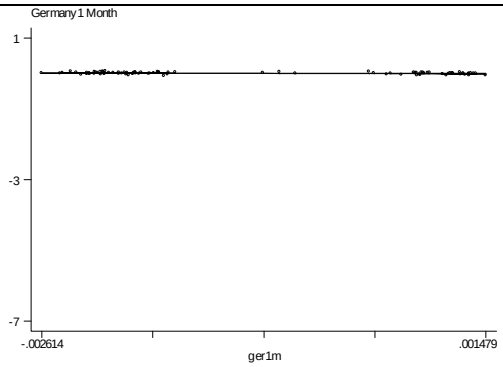
Euro



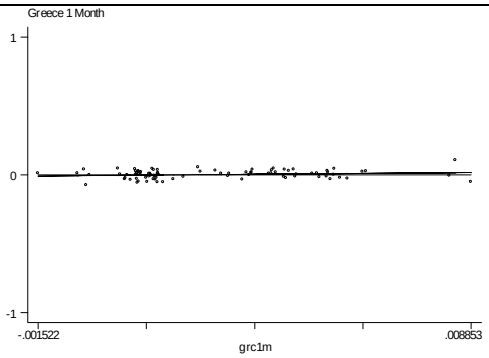
Finland



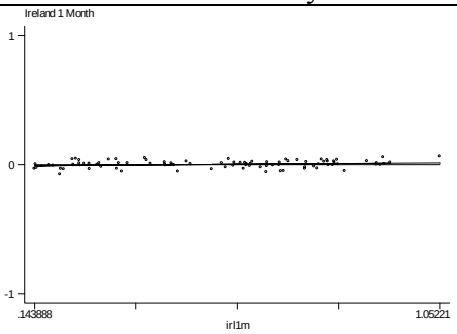
France



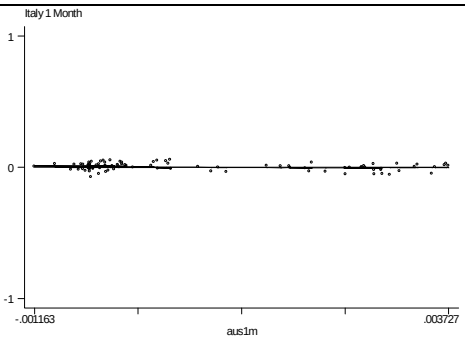
Germany



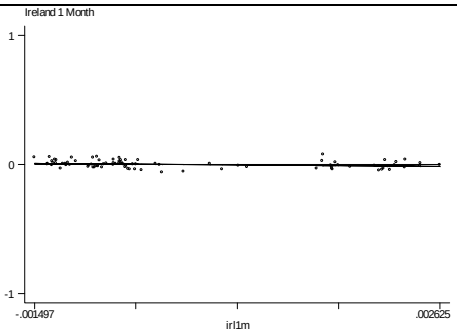
Greece



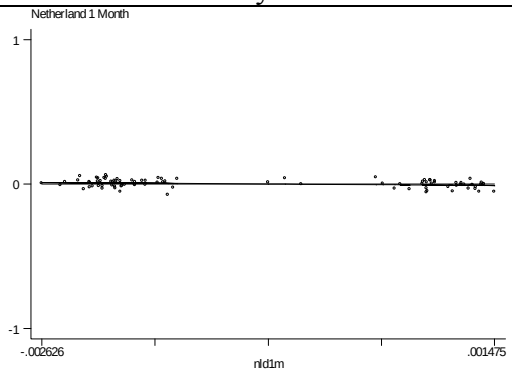
Ireland



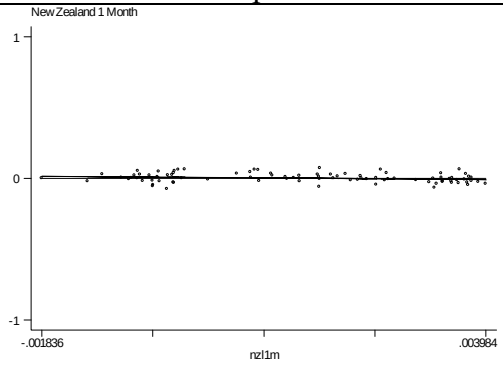
Italy



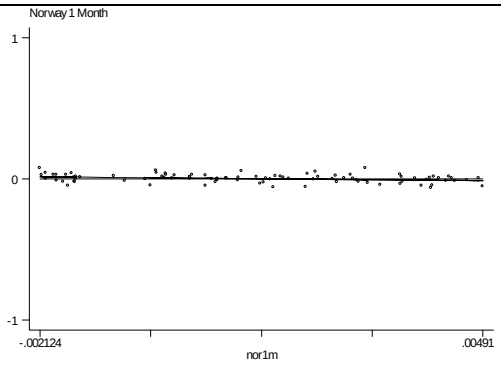
Japan



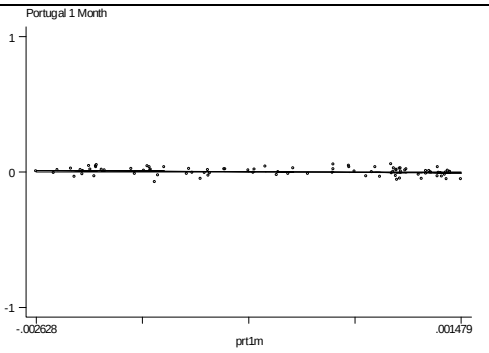
Netherlands



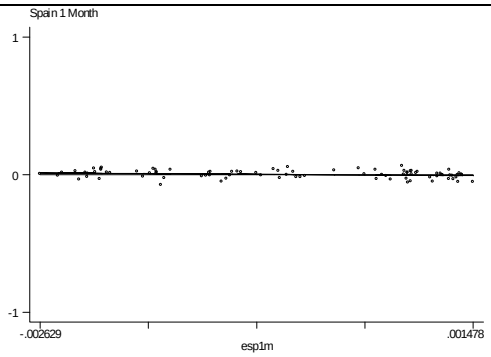
New Zealand



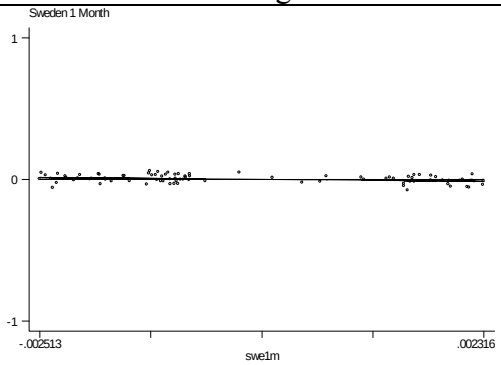
Norway



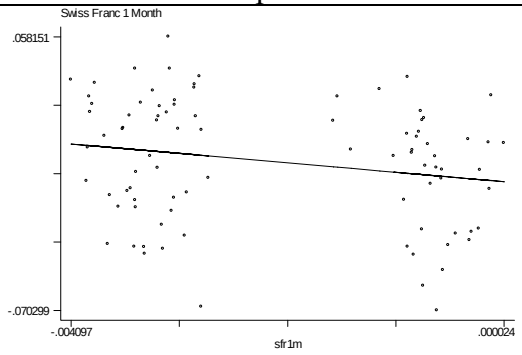
Portugal



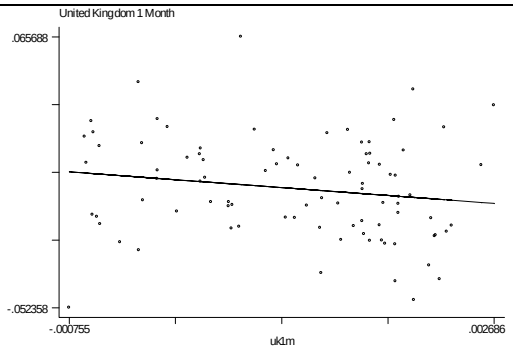
Spain



Sweden

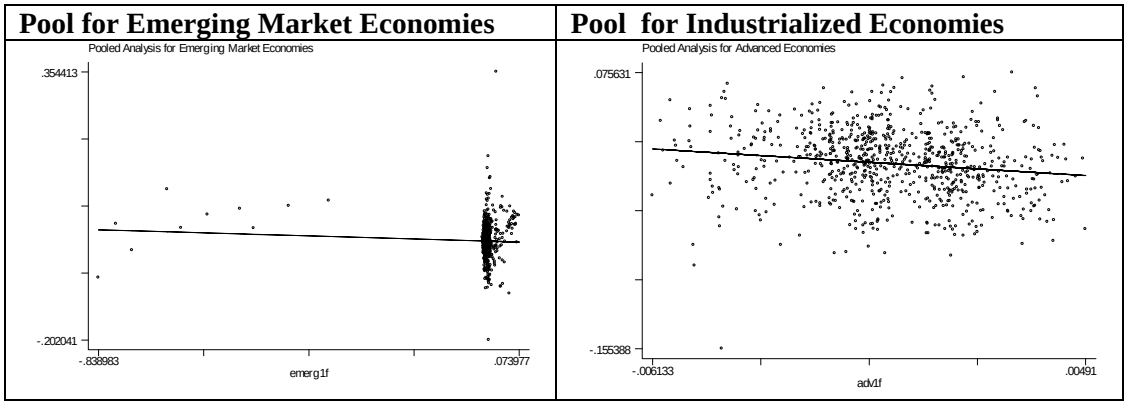


Switzerland



UK

Figure 3: Pooled Analysis (including 13 emerging market currencies)



Note: A reason for the bimodal distribution of data in the emerging market graph is the observations from Turkey, where a large depreciation occurred in early 2001. (Working Paper Appendices III and IV.)

Figure 4: Pooled Analysis (10 currencies in each category)

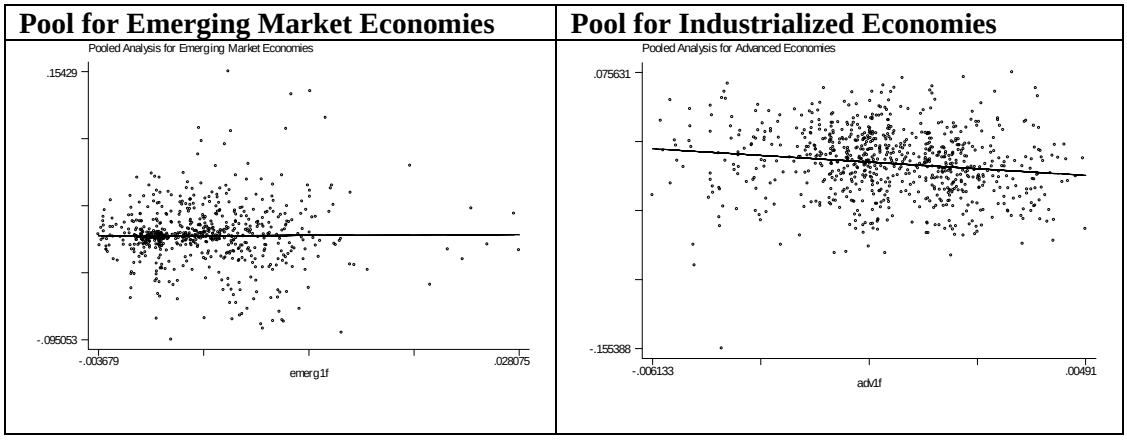


TABLE 1: Individual Advanced Country Regressions (12/31/96 – 04/30/04)

Coefficients with Robust Standard Errors (Forecast Horizon is One Month)

$$s_{t+1} - s_t = \alpha + \beta (f_t - s_t) + \varepsilon_{t+1}$$

	Dates	*N*	*β (S. E.)*	*t: β=0*	*t: β=1*	*DW*	*F Prob*
Advanced Economies							
1. Australia	12/96-4/04	88	-5.6437 (2.1666)	-2.60	9.40	1.95	0.0108
2. Austria	12/96-4/04	88	-5.2804 (1.9551)	-2.70	10.32	1.75	0.0083
3. Belgium	12/96-4/04	88	-5.5236 (1.9642)	-2.81	11.03	1.75	0.0061
4. Canada	12/96-4/04	88	-3.2183 (1.8926)	-1.70	4.97	1.96	0.0927
5. Denmark	12/96-4/04	88	-5.5150 (2.0319)	-2.71	10.28	1.76	0.0080
6. Euro	12/96-4/04	86	-5.6024 (2.0813)	-2.69	10.06	1.81	0.0086
7. Finland	12/96-4/04	88	-5.4680 (1.9057)	-2.87	11.52	1.78	0.0052
8. France	12/96-4/04	88	-5.1522 (1.9419)	-2.65	10.04	1.74	0.0095
9. Germany	12/96-4/04	88	-5.2964 (1.9384)	-2.73	10.55	1.75	0.0076
10. Greece	12/96-4/04	88	2.4052 (2.0348)	1.18	0.48	1.77	0.2405
11. Ireland	12/96-4/04	88	-5.6322 (2.1612)	-2.61	9.42	1.77	0.0108
12. Italy	12/96-4/04	88	-3.6422 (2.2115)	-1.65	4.41	1.66	0.1032
13. Japan	12/96-4/04	88	-1.2805 (2.0472)	-0.63	1.24	2.14	0.5333
14. Netherlands	12/96-4/04	88	-5.1816 (1.9166)	-2.70	10.40	1.76	0.0083
15. New Zealand	12/96-4/04	88	-3.9942 (2.0142)	-1.98	6.15	1.62	0.0506
16. Norway	12/96-4/04	88	-3.8507 (1.4636)	-2.63	10.98	2.18	0.0101
17. Portugal	12/96-4/04	88	-4.4242 (2.1870)	-2.02	6.15	1.69	0.0462
18. Spain	12/96-4/04	88	-4.8614 (2.2027)	-2.21	7.08	1.68	0.0300
19. Sweden	12/96-4/04	88	-5.5293 (1.8184)	-3.04	12.89	2.01	0.0031
20. Switzerland	12/96-4/04	88	-4.3037 (2.0588)	-2.09	6.64	1.85	0.0395
21. UK	12/96-4/04	88	-3.9999 (2.8715)	-1.39	3.03	2.10	0.1673

TABLE 2: Individual Emerging Market Country Regressions (12/31/96–04/30/04)
Coefficients with Robust Standard Errors. Forecast Horizon is One Month.

$$s_{t+1} - s_t = \alpha + \beta (f_t - s_t) + \varepsilon_t$$

	Dates	*N*	*β (S. E.)*	*t: β=0*	*t: β=1*	*DW*	*F Prob*
Emerging and Newly Industrialized Economies							
1. Czech Republic	12/96-4/04	88	0.4260 (0.6604)	0.65	0.76	1.90	0.5206
2. Hong Kong	12/96-4/04	88	-0.0439 (0.0376)	-1.17	768	2.44	0.2468
3. Hungary	10/97-4/04	78	0.7541 (1.2594)	0.60	0.04	1.82	0.5511
4. India	10/97-4/04	78	-0.6181 (0.8612)	-0.72	3.53	1.43	0.4751
5. Indonesia	12/96-12/02	73	0.1456 (0.2055)	0.71	17.28	1.55	0.4807
6. Kuwait	12/96-4/04	88	0.4050 (0.9394)	0.43	0.40	1.89	0.6674
7. Mexico	12/96-4/04	88	-0.6399 (0.4079)	-1.57	16.16	1.99	0.1204
8. Philippines	12/96-4/04	88	1.6770 (1.7128)	0.98	0.16	1.87	0.3303
9. Saudi Arabia	12/96-4/04	88	-0.0831 (0.0835)	-1.00	168.17	2.94	0.3223
10. Singapore	12/96-4/04	88	0.1911 (1.2898)	0.15	0.39	1.86	0.8826
11. South Africa	12/96-4/04	88	-3.2693 (1.8403)	-1.78	5.38	1.74	0.0792
12. Taiwan	12/96-4/04	88	0.1442 (0.5252)	0.27	2.65	1.75	0.7842
13. Thailand	12/96-4/04	88	0.9613 (0.6853)	1.40	0.00	1.62	0.1643
14. Turkey	12/96-4/04	88	-0.0031 (0.0284)	-0.11	1241	1.54	0.9133

Note on DW Stat: For the test of null hypotheses (no autocorrelation) at the 5% significance level, the appropriate dL and dU critical values for 80 to 99 observations and one explanatory variable are 1.61 and 1.66 respectively. I.e., we reject if d<1.61 and do not reject if d>1.66. For 60 to 79 observations, dL=1.55 and dU=1.62

TABLE 3: Seemingly Unrelated Regressions (Country-wise) [14]

	Coef.	Std. Err.	z	P>|z|
Advanced Economies				
Australia	-1.24691	1.494352	-0.83	0.404
Canada	-0.010953	1.738178	-0.01	0.995
Denmark	-2.189826	0.623724	-3.51	0.000
European Union	-2.258394	0.624710	-3.62	0.000
Japan	1.032035	1.463353	0.71	0.481
New Zealand	-1.607774	1.337827	-1.20	0.229
Norway	-2.331581	0.768280	-3.03	0.002
Sweden	-2.190423	0.887877	-2.47	0.014
Switzerland	-1.998467	0.799680	-2.50	0.012
UK	-2.040146	1.755574	-1.16	0.245
Emerging and Newly Industrialized Economies				
Czech Republic	-0.268865	0.625856	-0.43	0.667
Hong Kong	-0.025843	0.054466	-0.47	0.635
Hungary	-0.628215	0.642181	-0.98	0.328
India	-0.598888	0.542740	-1.10	0.270
Kuwait	0.897000	0.409053	2.19	0.028
Mexico	-0.863151	0.406361	-2.12	0.034
Philippines	-0.758016	0.701212	-1.08	0.280
Saudi Arabia	-0.070964	0.027124	-2.62	0.009
Singapore	0.174195	0.625553	0.28	0.781
South Africa	-1.638586	1.470407	-1.11	0.265
Taiwan	0.325223	0.410904	0.79	0.429
Thailand	-0.914912	0.465787	-1.96	0.050
Turkey	-0.028603	0.025821	-1.11	0.268

[14] Does not include Euro member countries (to avoid overlap of data with the Euro) and Indonesia (end date of available forward exchange rate data does not coincide with the data-sets available for the remaining countries)

TABLE 3 (continued)
Dates for Seemingly Unrelated Regressions are from 10/31/1997 to 4/30/04

Equation	Obs	Parms	RMSE	"R-sq"	chi2	P
ausspot	78	1	.0319	0.0273	.696	0.404
canspot	78	1	.0185	0.0002	.00004	0.995
dnkspot	78	1	.0266	0.0460	12.326	0.000
euspot	78	1	.0265	0.0522	13.069	0.000
jpnspot	78	1	.0364	-0.0074	.498	0.481
nzlspot	78	1	.0328	0.0275	1.444	0.229
norspot	78	1	.0273	0.0629	9.210	0.002
swespot	78	1	.0269	0.0677	6.086	0.014
sfrspot	78	1	.0271	0.0359	6.245	0.013
ukspot	78	1	.0207	0.0243	1.350	0.245
czespot	78	1	.0350	0.0004	.185	0.668
hkspot	78	1	.0010	0.0009	.225	0.635
hunspot	78	1	.0291	-0.0108	.957	0.328
indspot	78	1	.0118	0.0111	1.218	0.270
kwtspot	78	1	.0040	-0.0066	4.809	0.028
mexspot	78	1	.0254	0.0186	4.512	0.034
phlspot	78	1	.0309	-0.0018	1.169	0.280
sauspot	78	1	.0001	0.0791	6.845	0.009
sgpspot	78	1	.0187	0.0001	.078	0.781
safspot	78	1	.0465	0.0296	1.242	0.265
taispot	78	1	.0162	0.0005	.626	0.429
thaspot	78	1	.0413	-0.0060	3.858	0.050
turspot	78	1	.0580	-0.0049	1.227	0.268

TABLE 4: Pooled Country Regressions (10/31/97 – 04/30/2004)							
Pooled Data	***Dates***	***N***	***β (S. E.)***	***t: β=0***	***t: β=1***	***DW***	***FProb***
Emerging Economies[15]	12/96-4/04	1014	-0.0278 (0.0290)	-0.96	1252	1.68	0.3375
Advanced Economies[16]	02/97-4/04	780	-2.0231 (0.5426)	-3.73	31.04	1.89	0.0002

[15] Pooled Analysis of Emerging Economies does not include Indonesia. All dates are from 10/97 to 4/04.
[16] Pooled Analysis does not include the Euro countries. All dates are from 10/97 to 4/04.

TABLE 5: Seemingly Unrelated Regressions (Pooled) [17]

	Coef.	Std. Err.	z	P>|z|
Advanced Economies	-1.666	0.4503	-3.70	0.000
Emerging Market Economies	0.152	0.1896	0.80	0.422

Equation	Obs	Parms	RMSE	"R-sq"	χ2	P
advspot	780	1	.0281	0.0220	13.679	0.0002
emergspot	780	1	.0255	-0.0004	.645	0.4219

TABLE 5b: Pooled Country Regressions (10/31/97 – 04/30/04)

Pooled Data	***Dates***	***N***	***β (S. E.)***	***t: β=0***	***t: β=1***	***DW***	***FProb***
Emerging Economies	12/96-4/04	780	0.0377 (0.2436)	0.15	15.60	1.84	0.8769
Advanced Economies	02/97-4/04	780	-2.0231 (0.5426)	-3.73	31.04	1.89	0.0002

[17] Does not include Euro member countries (to avoid overlap of data with the Euro) and Indonesia (end date of available forward exchange rate data does not coincide with the data-sets available for the remaining countries)

Appendix Table 1: Individual Advanced Country Regressions (12/31/96 – 08/30/2004)

Coefficients with Robust Standard Errors (Forecast Horizon is One Month)

$$s_{t+1} - s_t = \alpha + \beta_1 (f_t - s_t) + \beta_2 (i_{t-12}) + \varepsilon_{t+1}$$

	Dates	*N*	*Cons*	*β_1 (S. E.)*	*β_2 (S. E.)*	*t:β_1=0*	*t:β_1=1*	*t:β_2=0*	*DW*	*F Prob*
Advanced Economies										
Australia	12/96-8/04	92	.0078 .0154	-5.0505 3.2276	-.0382 .2723	-1.56	3.51	-0.14	1.93	0.0636
Austria	12/96-8/04	92	.0002 .0078	-5.6939 2.2212	-.0668 .1719	-2.56	9.08	-0.39	1.77	0.0243
Belgium	12/96-8/04	92	.0005 .0078	-5.9971 2.2411	-.0771 .1722	-2.68	9.75	-0.45	1.77	0.0182
Canada	12/96-8/04	92	-.0100 .0061	-1.1265 1.8561	.2068 .1256	-0.61	1.31	1.65	2.07	0.0971
Denmark	12/96-8/04	92	.0003 .0077	-5.7296 2.2601	-.0374 .1659	-2.54	8.87	-0.23	1.79	0.0253
Euro	02/97-8/04	90	-.0006 .0076	-5.9019 2.3102	-.0516 .1647	-2.55	8.93	-0.31	1.83	0.0263
Finland	12/96-8/04	92	.0003 .0078	-5.9072 2.1822	-.0733 .1728	-2.71	10.02	-0.42	1.80	0.0157
France	12/96-8/04	92	.0001 .0078	-5.5488 2.2090	-.0648 .1722	-2.51	8.79	-0.38	1.76	0.0277
Germany	12/96-8/04	92	.0003 .0078	-5.7332 2.2123	-.0716 .1726	-2.59	9.26	-0.42	1.77	0.0225
Greece	12/96-8/04	92	-.0091 .0074	1.9845 2.2711	.1195 .1821	0.87	0.19	0.66	1.82	0.2758
Ireland	12/96-8/04	92	.0023 .0074	-5.2773 2.1898	-.0720 .1510	-2.41	8.22	-0.48	1.82	0.0355
Italy	12/96-8/04	92	-.0048 .0075	-3.0997 2.2900	.1177 .1539	-1.35	3.20	0.77	1.72	0.1958
Japan	12/96-8/04	92	-.0052 .0073	-.9652 2.9164	.0319 .2608	-0.33	0.45	0.12	2.17	0.8150
Netherlands	12/96-8/04	92	.0002 .0078	-5.5973 2.1891	-.0689 .1732	-2.56	9.08	-0.40	1.77	0.0244
New Zealand	12/96-8/04	92	-.0061 .0131	-2.4812 2.4693	.2426 .2083	-1.00	1.99	1.16	1.73	0.0399
Norway	12/96-8/04	92	.0073 .0093	-3.9050 1.4392	-.0343 .1691	-2.71	11.62	-0.20	2.19	0.0291
Portugal	12/96-8/04	92	-.0031 .0075	-4.0050 2.3263	.0631 .1587	-1.72	4.63	0.40	1.73	0.1224
Spain	12/96-8/04	92	-.0021 .0076	-4.6061 2.3594	.0354 .1600	-1.95	5.65	0.22	1.72	0.0863
Sweden	12/96-8/04	92	.0031 .0084	-6.0388 1.9837	-.0757 .1703	-3.04	12.59	-0.44	2.03	0.0078
Switzerland	12/96-8/04	92	-.0065 .0077	-4.9364 2.1919	-.0984 .1678	-2.25	7.33	-0.59	1.88	0.0796
UK	12/96-8/04	92	.0025 .0097	-3.5541 3.0169	.0199 0.1440	-1.18	2.28	0.14	2.20	0.3576

Appendix Table 2: Individual Emerging Market Country Regressions (12/31/96–08/30/2004)

Coefficients with Robust Standard Errors. Forecast Horizon is One Month.

$$s_{t+1} - s_t = \alpha + + \beta_1 (f_t - s_t) + \beta_2 (i_{t-12}) + \varepsilon_t$$

	Dates	*N*	*Cons (S.E.)*	*β_1 (S. E.)*	*β_2 (S. E.)*	*t:β_1=0*	*t:β_1=1*	*t:β_2=0*	*DW*	*F Prob*
Emerging and Newly Industrialized Economies										
Czech Republic	12/96-8/04	92	-.0048 .0092	.3732 .6550	.0749 .1897	0.57	0.92	0.39	1.93	0.7540
Hong Kong	12/96-8/04	92	.0000 .0004	-.0464 .0331	.0015 .0079	-1.40	997	0.20	2.48	0.3740
Hungary	10/97-8/04	82	-.0123 .0135	.5228 1.2547	.2038 .1778	0.42	0.14	1.15	1.92	0.4601
India	10/97-8/04	82	-.0028 .0037	-2.1689 .9660	.2816 .0993	-2.25	10.76	2.83	1.84	0.0204
Indonesia	12/96-12/02	73	-.0351 .0644	.2479 .2873	.9435 1.3663	0.86	6.85	0.69	1.56	0.6890
Kuwait	12/96-8/04	92	-.0011 .0011	.3779 .8779	.0149 .0211	0.43	0.50	0.71	1.92	0.6724
Mexico	12/96-8/04	92	.0071 .0061	-.7570 .4548	.0988 .1512	-1.66	14.92	0.65	1.98	0.2524
Philippines	12/96-8/04	92	-.0063 .0081	1.5433 1.7736	.1143 .1138	0.87	0.09	1.00	1.88	0.2833
Saudi Arabia	12/96-8/04	92	.0000 .0000	-.0829 .0832	.0001 .0004	-1.00	169	0.26	2.94	0.4736
Singapore	12/96-8/04	92	-.0032 .0033	.3746 1.3160	.1276 .0929	0.28	0.23	1.37	1.92	0.3520
South Africa	12/96-8/04	92	-.0097 .0217	-2.6554 1.7722	.7290 .3047	-1.50	4.25	2.39	2.00	0.0094
Taiwan	12/96-8/04	92	-.0053 .0029	-.3741 .5375	.1714 .0844	-0.70	6.53	2.03	1.76	0.1188
Thailand	12/96-8/04	92	-.0027 .0047	.8490 .6770	.1147 .1430	1.25	0.05	0.80	1.62	0.3528
Turkey	12/96-8/04	92	-.0210 .0140	.0258 .0288	1.095 .3012	0.89	1136	3.64	1.71	0.0021

Note on DW Stat: For the test of null hypotheses (no autocorrelation) at the 5% significance level, the appropriate dL and dU critical values for 80 to 99 observations and one explanatory valuable are 1.61 and 1.66 respectively. I.e., we reject if d<1.61 and do not reject if d>1.66. For 60 to 79 observations, dL=1.55 and dU=1.62

Appendix Table 3a: Seemingly Unrelated Regressions (Country-wise – Advanced Economies)[18]

Advanced Economies

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
ausspot						
aus1f	-.6090974	2.149171	-0.28	0.777	-4.821395	3.6032
ilev1yrlag	.2595897	.2350874	1.10	0.269	-.2011732	.7203526
_cons	-.0109909	.0126026	-0.87	0.383	-.0356916	.0137098
canspot						
can1f	2.217106	2.333359	0.95	0.342	-2.356193	6.790405
ilev1yrlag	.3115863	.1286719	2.42	0.015	.059394	.5637786
_cons	-.015134	.0063072	-2.40	0.016	-.0274959	-.0027721
dnkspot						
dnk1f	-1.837752	.6422256	-2.86	0.004	-3.096491	-.5790131
ilev1yrlag	.1354066	.1520151	0.89	0.373	-.1625376	.4333508
_cons	-.0071554	.0073626	-0.97	0.331	-.0215858	.0072751
euspot						
eu1f	-1.835098	.6597306	-2.78	0.005	-3.128146	-.5420498
ilev1yrlag	.1408113	.1517292	0.93	0.353	-.1565724	.438195
_cons	-.0076237	.0073282	-1.04	0.298	-.0219866	.0067392
jpnspot						
jpn1f	.4099371	1.870401	0.22	0.827	-3.255982	4.075856
ilev1yrlag	.1195707	.239772	0.50	0.618	-.3503738	.5895152
_cons	-.0051634	.0100863	-0.51	0.609	-.0249322	.0146053
nzdspot						
nzd1f	-1.743768	1.550389	-1.12	0.261	-4.782474	1.294937
ilev1yrlag	.2631562	.2078343	1.27	0.205	-.1441915	.670504
_cons	-.009437	.0113061	-0.83	0.404	-.0315966	.0127225
norspot						
nor1f	-2.280175	.7763444	-2.94	0.003	-3.801782	-.7585682
ilev1yrlag	.0369278	.1576541	0.23	0.815	-.2720686	.3459241
_cons	.0018782	.0078592	0.24	0.811	-.0135257	.017282
swespot						
swe1f	-1.992416	1.051104	-1.90	0.058	-4.052543	.0677105
ilev1yrlag	.1444558	.1613433	0.90	0.371	-.1717713	.4606829
_cons	-.0066412	.0077403	-0.86	0.391	-.021812	.0085295
swfspot						
swf1f	-2.43158	.8510268	-2.86	0.004	-4.099561	-.7635976
ilev1yrlag	.0336786	.1579499	0.21	0.831	-.2758975	.3432548
_cons	-.0074463	.007548	-0.99	0.324	-.0222402	.0073476
ukspot						
uk1f	-1.958035	1.99615	-0.98	0.327	-5.870417	1.954347
ilev1yrlag	.0920992	.1351497	0.68	0.496	-.1727894	.3569878
_cons	-.0026584	.0077863	-0.34	0.733	-.0179194	.0126025

[18] Seemingly Unrelated Regression (SUR) does not include Euro member countries (to avoid overlap of data with the Euro) and Indonesia (end date of available forward exchange rate data does not coincide with the data-sets available for the remaining countries)

Appendix Table 3b:
Seemingly Unrelated Regressions (Country-wise – Emerging Economies)
Emerging and Newly Industrialized Economies

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
czespot						
cze1f	-.1062047	.6466152	-0.16	0.870	-1.373547	1.161138
ilev1yrlag	.0666965	.2041784	0.33	0.744	-.3334859	.4668788
_cons	-.0055495	.0097957	-0.57	0.571	-.0247487	.0136496
hkspot						
hk1f	-.0251463	.0548767	-0.46	0.647	-.1327027	.0824101
ilev1yrlag	.0016835	.0058658	0.29	0.774	-.0098131	.0131802
_cons	.0000446	.0002801	0.16	0.874	-.0005044	.0005936
hunspot						
hun1f	-.5206165	.6200487	-0.84	0.401	-1.73589	.6946567
ilev1yrlag	.2155056	.163519	1.32	0.188	-.1049858	.5359971
_cons	-.0051701	.0090067	-0.57	0.566	-.0228229	.0124828
indspot						
ind1f	-2.094624	.5462061	-3.83	0.000	-3.165168	-1.02408
ilev1yrlag	.2774432	.069823	3.97	0.000	.1405926	.4142937
_cons	-.0028833	.0030698	-0.94	0.348	-.0089	.0031334
kwtspot						
kwt1f	.7145258	.3940511	1.81	0.070	-.0578001	1.486852
ilev1yrlag	.0175572	.0229027	0.77	0.443	-.0273313	.0624457
_cons	-.0015842	.0011512	-1.38	0.169	-.0038406	.0006721
mexspot						
mex1f	-.9546764	.4583512	-2.08	0.037	-1.853028	-.0563244
ilev1yrlag	.1016194	.1647853	0.62	0.537	-.2213537	.4245926
_cons	.0083986	.0071179	1.18	0.238	-.0055522	.0223495
phpspot						
php1f	-.9409439	.6966108	-1.35	0.177	-2.306276	.4243882
ilev1yrlag	.1609941	.1780513	0.90	0.366	-.1879801	.5099683
_cons	.0040508	.008989	0.45	0.652	-.0135673	.0216689
sauspot						
sau1f	-.0710727	.0265758	-2.67	0.007	-.1231602	-.0189852
ilev1yrlag	-5.88e-06	.0006387	-0.01	0.993	-.0012576	.0012459
_cons	.0000223	.0000321	0.70	0.486	-.0000405	.0000852
sgpspot						
sgp1f	.0917971	.632145	0.15	0.885	-1.147184	1.330778
ilev1yrlag	.0836068	.1071506	0.78	0.435	-.1264046	.2936182
_cons	-.0026112	.0051946	-0.50	0.615	-.0127924	.00757
safspot						
saf1f	-1.604801	1.46348	-1.10	0.273	-4.473169	1.263568
ilev1yrlag	.7627199	.261873	2.91	0.004	.2494582	1.275982
_cons	-.018458	.0174532	-1.06	0.290	-.0526657	.0157497
taispot						
tai1f	-.0106561	.445279	-0.02	0.981	-.8833868	.8620747
ilev1yrlag	.110728	.096842	1.14	0.253	-.0790788	.3005347
_cons	-.0037858	.0046034	-0.82	0.411	-.0128082	.0052366
thaspot						
tha1f	-1.133166	.4784788	-2.37	0.018	-2.070967	-.1953645
ilev1yrlag	.1399682	.2379905	0.59	0.556	-.3264847	.6064211
_cons	-.0032163	.0114265	-0.28	0.778	-.0256118	.0191792
turspot						
tur1f	-.0000766	.0259992	-0.00	0.998	-.0510341	.050881
ilev1yrlag	.9717234	.3312556	2.93	0.003	.3224744	1.620972
_cons	-.0178609	.01569	-1.14	0.255	-.0486128	.0128909

Dates for Seemingly Unrelated Regressions are from 10/31/1997 to 8/30/2004

Equation	Obs	Parms	RMSE	"R-sq"	chi2	P
ausspot	82	2	.0311295	0.0370	2.876971	0.2373
canspot	82	2	.0178343	0.0448	6.252343	0.0439
dnkspot	82	2	.0259927	0.0496	9.975345	0.0068
euspot	82	2	.0259548	0.0545	9.738021	0.0077
jpnspot	82	2	.0354747	0.0016	.2500312	0.8825
nzdspot	82	2	.0318026	0.0554	5.188638	0.0747
norspot	82	2	.0270753	0.0610	8.869796	0.0119
swespot	82	2	.0264799	0.0721	6.20474	0.0449
swfspot	82	2	.0267093	0.0417	8.743628	0.0126
ukspot	82	2	.0204978	0.0311	2.607678	0.2715
czespot	82	2	.0344863	0.0015	.119561	0.9420
hkspot	82	2	.0009752	0.0017	.2439022	0.8852
hunspot	82	2	.0280756	0.0131	2.352753	0.3084
indspot	82	2	.0107387	0.1770	21.21513	0.0000
kwtspot	82	2	.0039233	0.0028	3.780866	0.1510
mexspot	82	2	.0248683	0.0170	4.51434	0.1046
phpspot	82	2	.0300656	0.0057	2.298681	0.3168
sauspot	82	2	.0001092	0.0795	7.181166	0.0276
sgpspot	82	2	.018267	0.0075	.6150835	0.7353
safspot	82	2	.0445779	0.1186	10.54344	0.0051
taispot	82	2	.0157674	0.0172	1.427172	0.4899
thaspot	82	2	.0403344	-0.0051	5.652978	0.0592
turspot	82	2	.0538321	0.1042	9.61522	0.0082

Appendix Table 4: Pooled Country Regressions (10/31/97 – 08/30/2004)

Coefficients with Robust Standard Errors (Forecast Horizon is One Month)

$$s_{t+1} - s_t = \alpha + \beta_1 (f_t - s_t) + \beta_2 (i_t) + \varepsilon_{t+1}$$

	Dates	*N*	*Cons*	*β_1 (S. E.)*	*β_2 (S. E.)*	*t:β_1=0*	*t:β_1=1*	*t:β_2=0*	*DW*	*F Prob*
Pooled Data										
Emerging Economies[19]	12/96-8/04	1066	-0.0051 0.0020	-0.0231 0.0288	0.1871 0.0449	-0.80	1257	4.16	1.71	0.0001
Advanced Economies[20]	12/96-8/04	820	-0.0066 0.0024	-1.5035 0.5502	0.1352 0.0510	-2.73	20.70	2.65	1.95	0.0000

[19] Pooled Analysis of Emerging Economies does not include Indonesia (end date of available forward exchange rate data does not coincide with the data-sets available for the remaining countries). All dates are from 10/97 to 4/04.

[20] Pooled Analysis of Advanced Economies. does not include the Euro countries. All dates are from 10/97 to 4/04.

Appendix Table 5: Seemingly Unrelated Regressions I (Pooled without Saudi Arabia, Turkey and Hong Kong)

Dates for Seemingly Unrelated Regressions are from 10/31/1997 to 8/30/2004

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
		Emergspot				
Emerg1F	-.0228291	.0133644	-1.71	0.088	-.0490227	.0033646
ilev1yrlag	.1476253	.0516335	2.86	0.004	.0464254	.2488251
_cons	-.0029744	.0025061	-1.19	0.235	-.0078863	.0019375
		Advspot				
Adv1F	-1.54993	.4849217	-3.20	0.001	-2.500359	-.5995014
ilev1yrlag	.1332615	.0551209	2.42	0.016	.0252266	.2412965
_cons	-.0065915	.002649	-2.49	0.013	-.0117836	-.0013995

Equation	Obs	Parms	RMSE	"R-sq"	chi2	P
Emergspot	820	2	.0278	0.0146	12.16366	0.0023
Advspot	820	2	.0275328	0.0294	25.80536	0.0000

Note: SUR analysis requires same number of observations for data under analysis. In this case emerging market economies were reduced from 1066 observations to 820 by dropping three countries. The countries dropped were: Saudi Arabia, Turkey and Hong Kong. These countries were chosen as they have fixed exchanges exchange rates/capital controls.

Appendix Table 6: Seemingly Unrelated Regressions II (Pooled without Taiwan, Thailand and Turkey)[21]

Dates for Seemingly Unrelated Regressions are from 10/31/1997 to 8/30/2004

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Emergspot						
Emerg1F	-.0496556	.2059858	-0.24	0.810	-.4533805	.3540692
ilev1yrlag	.1566065	.0534172	2.93	0.003	.0519107	.2613023
_cons	-.0052057	.0025864	-2.01	0.044	-.0102749	-.0001366
Advspot						
Adv1F	-1.216873	.4729104	-2.57	0.010	-2.14376	-.2899858
ilev1yrlag	.1478042	.0549216	2.69	0.007	.04016	.2554485
_cons	-.0072434	.0026407	-2.74	0.006	-.0124191	-.0020677

Equation	Obs	Parms	RMSE	"R-sq"	chi2	P
Emergspot	820	2	.0284822	0.0107	8.663442	0.0131
Advspot	820	2	.0275382	0.0290	22.21049	0.0000

Note: SUR analysis requires same number of observations for data under analysis. In this case emerging market economies were reduced from 1066 observations to 820 arbitrarily by dropping three countries.
The countries dropped were: Taiwan, Thailand and Turkey, the last three countries listed alphabetically.

[21] Does not include Indonesia (end date of available forward exchange rate data does not coincide with the data-sets available for the remaining countries).